

SHORT COMMUNICATION

An unusual setule on type IV urticating setae of *Homoeomma uruguayense* (Araneae: Theraphosidae)Carlos Perafán and Fernando Pérez-Miles¹: Sección Entomología, Facultad de Ciencias, Iguá 4225, 11400 Montevideo, Uruguay

Abstract. We describe a new unusual setule on type IV urticating setae of the theraphosid spider *Homoeomma uruguayense* (Mello-Leitão 1946). These processes have a filiform stalk and a funnel-like apex that arise from the main axis of the urticating seta. The probable function of these structures in passive and active defense is discussed.

Keywords: Tarantulas, morphology

The presence of defensive urticating setae is exclusive to the Theraphosidae of Southern North America, Central and South America. These setae have attracted the attention of naturalists since the nineteenth century. Cooke et al. (1972) were the first to describe four types of theraphosid urticating setae and presented a detailed study of their morphology. After that, Marshall & Uetz (1990a) reported type V urticating setae located on the pedipalps in the genus *Ephebopus* Simon 1892, and Pérez-Miles (1998) described type VI abdominal urticating setae in the genus *Hemirrhagus* Simon 1903. Over the last decades, several papers on structure, function, and development of urticating setae have appeared. Also, it has become common practice for scientists to use urticating setae as systematic characters in phylogenetic analysis (Bertani 2001, 2002; Pérez-Miles 1992, 2000; Pérez-Miles et al. 1996).

Theraphosinae have small urticating setae of types I, III, IV (Fig. 1), and VI. These setae types are released by friction of the posterior legs against the abdomen. Urticating setae can be released when the tarantula is disturbed or can be incorporated into the shedding mat or cocoon (Marshall & Uetz 1990b; Pérez-Miles & Costa 1994) as passive defense against ants (Bertani & Guadanucci 2003). In Theraphosinae, types I and III can coexist and also type III and type IV, but types I and IV never occur together.

Homoeomma Ausserer 1871 has urticating setae types III and IV. Type III setae occupy a central dorsal area of the abdomen, while type IV are located in the periphery; at the border between both areas setae of intermediate morphology occur. In *Homoeomma uruguayense* (Mello-Leitão 1946), adult females lose type III urticating setae, whereas adult males maintain both types.

Having occasionally observed an unknown setular morphology on type IV urticating setae of *H. uruguayense*, we chose to study the morphology of type IV urticating setae on 23 males and 7 females of *H. uruguayense* from Montevideo, Canelones and Rio Negro, Uruguay (old and fresh material). We deposited the materials studied in the entomological collection, Facultad de Ciencias, Montevideo, Uruguay. Additionally, we studied a male of *Homoeomma brasiliannum* (Chamberlin 1917) from Mairiporã, São Paulo, Brazil, deposited in the Instituto Butantan, São Paulo, Brazil (= IBSP); 3 males of *Homoeomma montanum* (Mello-Leitão 1923) from Itatiaia, Rio de Janeiro, Brazil, deposited at IBSP; a male (type) of *Homoeomma pictum* (Pocock 1903) from Caraz, Perú, deposited in The Natural History Museum, London, UK (= BMNH); and a male (type) of *Homoeomma villosum* (Keyserling 1891) from Taquara, Rio Grande do Sul, Brazil, deposited in BMNH.

We removed urticating setae with forceps from at least six areas of the abdomen (anterior, median and posterior; axial and lateral). At least 20 setae of each area were examined. We studied all specimens with optical microscopy and three with a scanning electron microscope; in these individuals, 43 setulae from 10 setae were measured.

We found type IV urticating setae in all *Homoeomma* spp. examined. We discovered an undescribed structure (Fig. 2) on type IV urticating setae of all *H. uruguayense* individuals. These structures (setules) have a filiform stalk and a funnel-like apex. Setules measured $18.68 \mu\text{m} \pm 3.39 \text{SD}$ in length. They are fixed to the main axis of the setae between the subconical barbs of type IV setae. A mean of $5.6 (\pm 2.5 \text{SD}, n = 50)$ setules per seta occurred only on barbed zones of urticating setae. Exceptionally we observed such setules on setae of intermediate morphology (III/IV). They were not present in the urticating setae of *H. brasiliannum*, *H. montanum*, *H. pictum*, or *H. villosum*.

The function of the new setule remains obscure. Its morphology resembles structures associated with an adhesive function in insects and spiders (Nachtigall 1974; Rovner 1978; Stork 1980a; Roscoe & Walker 1991; Gorb 2001; Scherge & Gorb 2001; Gao & Yao 2004). For this reason, setules could represent contact elements that improve the action of adhesive forces (Kesel et al. 2003). Another possible explanation for setule function would be to increase the surface of the setae, facilitating flotation and transport through the air. A third alternative could be that setules help to maintain urticating setae on the substrate in a position with the penetration tip better exposed and ready for passive defense.

The finding of setules only on urticating setae of this species and not in others of the genus could be interpreted as an apomorphic acquisition of *H. uruguayense*.

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LITERATURE CITED

- Bertani, R. 2001. Revision, cladistic analysis, and zoogeography of *Vitalius*, *Nhandu*, and *Proshaplopus*, with notes on other theraphosine genera (Araneae, Theraphosidae). *Arquivos de Zoologia* 36:265–356.
- Bertani, R. 2002. Morfologia e evolução das cerdas urticantes em Theraphosidae (Araneae). Thesis (unpublished), Instituto de Biociências, Universidade de São Paulo, Brasil.
- Bertani, R. & J.P.L. Guadanucci. 2003. Cerdas urticantes de tarantulas (Araneae, Theraphosidae): defesa contra formigas (Hymenoptera: Formicidae)? *Actas IV Encontro Aracnólogos Cone Sul*, 249.
- Cooke, J.A.L., V.D. Roth & F.H. Miller. 1972. The urticating hairs of the theraphosid spiders. *American Museum Novitates* 2498:1–43.
- Gao, H. & H. Yao. 2004. Shape insensitive optimal adhesion of nanoscale fibrillar structures. *Proceedings of the National Academy of Sciences USA* 101:7851–7856.

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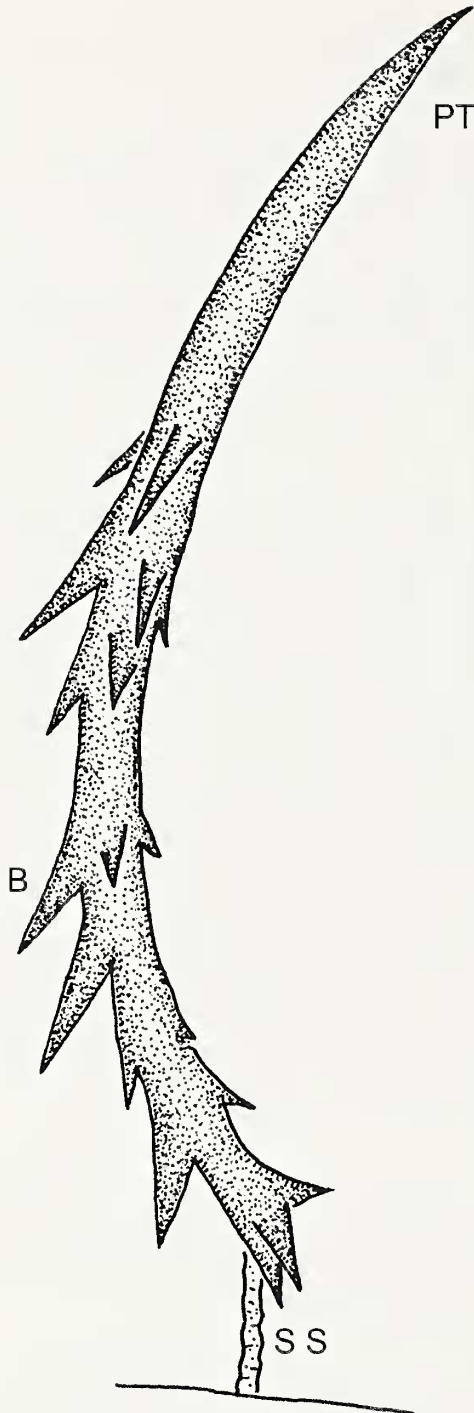


Figure 1.—Schematic representation of an usual abdominal type IV urticating seta of Theraphosinae showing the supporting stalk (SS), barbs (B), and penetration tip (PT). (Scale = 20 μ m).

- Gorb, S.N. 2001. Attachment Devices of Insect Cuticle. Kluwer Academic Publisher, Dordrecht, The Netherlands.
- Kesel, A.B., A. Martin & T. Seidl. 2003. Adhesion measurements on the attachment devices of the jumping spider *Evarcha arcuata*. *Journal of Experimental Biology* 206:2733–2738.
- Marshall, S.D. & G.W. Uetz. 1990a. The pedipalpal brush of *Epebopus* sp. (Araneae, Theraphosidae): Evidence of a new site for urticating hairs. *Bulletin of the British Arachnological Society* 8:122–124.
- Marshall, S.D. & G.W. Uetz. 1990b. Incorporation of urticating hairs into silk: A novel defense mechanism in two Neotropical

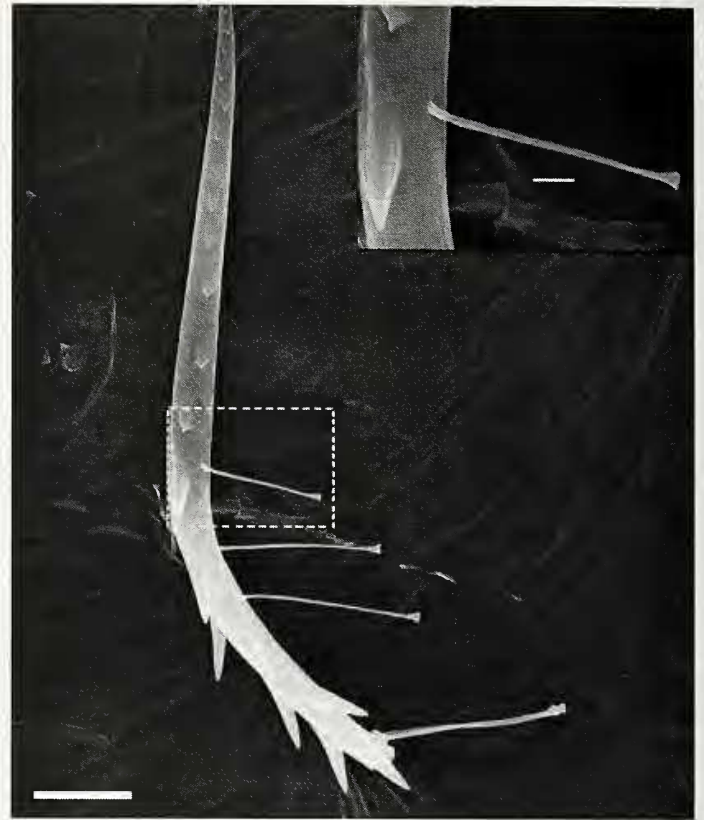


Figure 2.—Scanning electron microscope photograph of the abdominal type IV urticating setae of *H. uruguayense* showing the setules (Scale = 10 μ m). Insert: close-up of the setulac showing the flared apical tip (Scale = 2 μ m).

- tarantulas (Araneae, Theraphosidae). *Journal of Arachnology* 18:143–149.
- Nachtigall, W. 1974. *Biological Mechanisms of Attachment*. Springer, Berlin.
- Pérez-Miles, F. 1992. Análisis cladístico preliminar de la subfamilia Theraphosinae (Araneae, Theraphosidae). *Boletín de la Sociedad Zoológica del Uruguay* (2a. Epoca) 7:11–12.
- Pérez-Miles, F. 1998. Notes on the systematics of the little known theraphosid spider *Hemirrhagus cervinus*, with a description of a new type of urticating hair. *Journal of Arachnology* 26:120–123.
- Pérez-Miles, F. 2000. *Iracema cabocla* new genus and species of a theraphosid spider from Amazonic Brazil (Araneae, Theraphosidae). *Journal of Arachnology* 28:114–148.
- Pérez-Miles, F. & F.G. Costa. 1994. *Acanthoscurria atrox* incorporates urticating hairs into its shedding mat. *Forum American Tarantula Society* 3:63–64.
- Pérez-Miles, F., S.M. Lucas, P.I. da Silva, Jr. & R. Bertani. 1996. Systematic revision and cladistic analysis of Theraphosinae (Araneae: Theraphosidae). *Mygalomorph* 1:33–68.
- Roscoe, D.T. & G. Walker. 1991. The adhesion of spiders to smooth surfaces. *Bulletin of the British Arachnological Society* 8:224–226.
- Rovner, J.S. 1978. Adhesive setae in spiders: behavioral functions and hydraulically mediated movement. *Symposium of the Zoological Society London* 42:99–108.
- Scherge, M. & S.N. Gorb. 2001. *Biological Micro- and Nanotribology: Nature's Solutions*. Springer, Berlin.
- Stork, N.E. 1980. A scanning electron microscope study of tarsal adhesive setae in the Coleoptera. *Zoological Journal of the Linnean Society* 68:173–306.

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